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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/576,230
Filing Date: April 14, 2006
Appellant(s): YABE ET AL.

Terryence F. Chapman
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed April 24, 2009 appealing from the Office action mailed October 20, 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

4,834,796	KONDO ET AL	5-1989
2003/0160326	UZOH ET AL	8-2003
2001/0021466	MAENOSONO	9-2001
2002/0011176	YOSHIDA ET AL	1-2002
2004/0152303	VERBUNT	8-2004
01/49898	WO	7-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Ground 1. Claim 6 stands finally rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo et al (US 4834796) in view of Uzoh et al (US 2003/0160326), Maenosono (US 2001/0021466) and WO 01/49898 (hereinafter '898).

Kondo teaches an electroless copper plating method. *Column 1, lines 5-15.* An electroless copper plating solution is provided. *Column 2, lines 20-25 and column 13, line 30 through column 14, line 10.* The plating solution can comprise a first reducing agent (formalin) and a second hypophosphite reducing agent. *Column 13, line 30 through column 14, line 10.* The plating solution can also comprise a stablizer (2,2'-bipyridyl), which would inhibit copper deposition. *Column 13, lines 55-60 and column 6, lines 25-40 (as the material claimed by appellant for this purpose --see claim 5-- is used, it is understood to have the same effect).* A surface to be plated is provided, which can be a variety of materials. *Column 1, lines 5-15, column 5, lines 45-50, column 7, lines 50-60, column 9, lines 45-50 (metal, glass epoxy, paper phenol can all be plated for example).* The surface to be plated is plated with the plating solution. *Column 9, lines 45-60.* The addition of the second hypophosphite reducing agent provides desirable acceleration of the plating reaction when used with a TEA complexing agent. *Column 13, line 65 through column 14, line 10 and Figure 9.* Kondo also shows catalyzing the surface to be plated with palladium before the electroless plating. *Column 9, lines 45-55.*

Kondo teaches all the features of this claim except the coating of the mirror surface with the claimed surface roughness and the plating thickness of 500 nm or less, and the application of the noble metal/silane pretreatment agent before the electroless plating.

However, Uzoh teaches that it is well known when providing copper electroless plating that it is desirable to overplate substrates formed from silicon wafers, for

example. *Paragraphs [0005]–[0006].* The desirable copper plating can be 2-250 nm for a seed layer and 200 nm, for example, on a seed layer from a plating bath. *Paragraphs [0006] and [0008].*

Furthermore, Maenosono teaches that silicon wafers and other substrates including steel with a roughness Ra (average surface roughness) of 10 nm or less, preferably 5 nm or less, are commonly coated by electrochemical deposition methods, for example. *Paragraph [0030].*

Furthermore, '898 teaches a desirable pretreatment agent to provide palladium on a surface with a mirror finish such as a semiconductor wafer of silicon is by using a pretreatment agent with a noble metal compound (including palladium as the noble metal) reacted or mixed in advance with a silane coupling agent having a functional group with metal capturing capability. *Abstract and Example 5, pages 12-13 (see also pages 5, 6 and 22-23 of the translation).* The pretreatment agent is applied to the substrate and then electroless plating is performed. *Abstract (see also page 6 of the translation).* The plating can be using copper. *Example 5, pages 12-13 (see also page 23 of the translation).*

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Kondo to provide plating over a silicon wafer substrate with a mirror surface (roughness less than 10 nm) to provide a thin film of less than 500 nm thick as suggested by Uzoh and Maenosono in order to provide a desirable plating on such silicon substrates as Kondo teaches a desirable copper electroless plating bath, with plating conditions that can provide nm thickness coatings based on amounts of

reducing agent used and time of plating (see range of Figures 9 and 10) and indicates that a variety of substrates can be used and Uzoh teaches that it is well known to desire to provide electroless copper plating of 200 nm thickness, for example, over silicon wafer surfaces, and Maenosono teaches that silicon wafer surfaces to be coated can desirably have average surface roughness of less than 5 nm, for example. Furthermore, it would also have been obvious to modify Kondo in view of Uzoh and Maenosono to use a silane coupling agent pretreatment agent as suggested by '898 in order to provide a desirable adherence of the plating when desiring to coat such a mirrored surface, because Kondo teaches to provide a catalyst of palladium before plating, for example, and '898 teaches a desirable way to adhere a catalyst such as palladium using silane coupling agent as claimed before electrolessly plating as a treatment to a mirrored finish surface, such as a silicon wafer.

Ground 2. Claim 5 stands finally rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo in view of Uzoh, Maenosono and '898 as applied to claim 6 above, and further in view of Yoshida et al (US 2002/0011176) and Verbunt (US 2004/0152303).

Kondo in view of Uzoh, Maenosono and '898 teaches all the features of this claim except the specific first reducing agent and the use of hypophosphorous acid as the second reducing agent. Kondo does teach the stabilizing agent of 2,2'-bipyridyl. Column 13, lines 55-60 and column 6, lines 25-40.

However, Yoshida teaches that when providing copper electroless plating solutions, it is known to exchange formalin for glyoxylic acid as a reducing agent to provide a less problematic material, and that glyoxylic acid has a structure similar to formalin and is believed to having a oxidation reaction mechanism similar to formalin; however, the plating reaction proceeds more slowly than with formalin. *Paragraphs [0004]-[0007].*

Furthermore, Verbunt teaches that when providing copper electroless plating solutions it is well known to provide hypophosphite in the form of sodium hypophosphite or to provide the hypophosphite from hypophosphorous acid. *Paragraphs [0023] and [0026].*

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Kondo in view of Uzoh, Maenosono and '898 to use glyoxylic acid as the first reducing agent as suggested by Yoshida in order to provide a desirable less problematic reducing agent because Kondo teaches to provide a reducing agent of formalin, and Yoshida teaches that it is well known to replace formalin with glyoxylic acid as a reducing agent with an expectation of similar reaction mechanism, but with less problems. One of ordinary skill in the art would expect the hyphophosite second reducing agent in Kondo to act in the same beneficial speeded reaction way with glyoxylic acid, because formalin has a similar reaction mechanism, and this speeded reaction is desired because glyoxylic acid solutions proceed more slowly. It would further have been obvious to modify Kondo in view of Uzoh, Maenosono, '898 and

Yoshida to further replace the hypophosphite of Kondo with hypophosphorous acid as suggested by Verbunt with an expectation of desirable plating results, because Verbunt shows that hypophosphorous acid is a known desirable source for hypophosphite in copper electroless plating baths.

(10) Response to Argument

At pages 2-3 of the Appeal Brief of April 24, 2009, appellant first sets forth a description of the present invention. The Examiner notes that appellant's listed benefit of "enables a uniform plating to be formed at lower temperatures" is not claimed. The Examiner further notes that the feature of preventing "excessive deposition reactions" is also not claimed.

Ground 1. The Rejection of Claim 6 under 35 USC 103(a) using Kondo, Uzoh, Maenosono and '898

At pages 3-4 of the Appeal Brief, appellant argues that while Kondo discloses that sodium hypophosphite can be added to a first reducing agent of formalin to reduce the amount of formalin used, it discloses in Figures 9 and 10 that the plating rate for (a) formalin and sodium hypophosphite and (b) formalin alone are almost equal, and thus the reference only provides that sodium hypophosphite can be used as a partial substitute for formaldehyde and no unexpected results occur when the sodium hypophosphite is combined with formaldehyde. Appellant also argues that Kondo has no disclosure as to plating a "mirror surface", rather disclosing that the article is

pretreated, which means cleaned and chemically roughened, and catalyzed to make the substrate sensitive to copper deposition, and therefore, the reference does not disclose the provision of the mirror surface and its roughness features, the pretreatment with the silane coupling agent/noble metal compound, and the formation of a thin film with the claimed thickness by electroless copper plating.

The Examiner has reviewed this argument, however, her position is maintained. As to the use of a combination of formalin and sodium hyophosphite, firstly it is an obvious benefit to replace at least some of a problematic material with another less problematic material as described at column 14, lines 30-45 of Kondo, since then, less of the problematic material needs to be used. Secondly, according to Kondo, furthermore, it would not have been expected that the formalin/sodium hypophosphite combination would even have the deposition rate of formalin alone because while sodium hypophosphite was a generally known reducing agent, it had not previously been used in electroless copper plating except as an activator according to Kondo (column 13, lines 35-45), and therefore, by the teaching of Kondo, unexpected benefits of quick deposition rate and lowered use of problematic material is provided. Furthermore, Kondo provides that "From FIG. 9, it is certain that sodium hypophosphite, although it does not act alone, effectively accelerates the plating reaction if used in combination with formalin." (column 14, lines 5-10). Thirdly, as well, the combination of formalin/sodium hyophosphite is further shown by Kondo to have an even better and more desirable plating rate than formalin alone in Figure 9 where the solid line of

Figure 9 shows that the deposition rate of copper is significantly and measurably higher when sodium hyophosphite is added to the formalin when used with a TEA complexing agent (which is not prevented by the present clams). This clearly provides motivation to replace formalin alone with a combination of formalin/sodium hypophosphite with an expectation of improved results. As to the use of a mirrored surface, Kondo does not specifically teach treating such a surface. However, Kondo teaches that a variety of surfaces can be treated, including glass epoxy, paper phenol or stainless steel (column 7, lines 50-60 and column 9, lines 20-25 and 45-50), indicating that the material of the substrate is not important as long as it is catalyzed to accept a copper electroless plating. Moreover, as to the substrate being "pretreated" by cleaning and chemically roughening, and thus not having a surface roughness of less than 10 nm, Kondo does not require roughening. At column 7, lines 53-60, Kondo provides that the procedures of plating can be "conventional" and goes on to provide that "generally, an article or substrate to be treated . . is pretreated (cleaned and mechanically roughened). . ." However, this statement as to roughening is merely exemplary ("generally" certainly does not mean all the time) and as noted in MPEP 2123 (II) "Disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments. In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971)." In fact, the substrate used in the Examples of Kondo (a stainless steel plate) is simply described as cleaned and then treated with Pd catalyzing solution before electroless plating (column 9, lines 45-50), indicating that roughening is

not needed before plating. Moreover, the Examiner notes that the cited reference to '898 shows that pretreatment of mirrored finish surfaces using the noble metal/silane (catalyst) is also a "conventional" treatment. The Examiner notes that Kondo also provides that the electrolessly plated copper layer can be 0.2 to 0.3 microns (200-300 nm) thick, within the claimed range (column 9, lines 20-30). As to the specific use of the mirror finished substrate with the roughness less than 10 nm, the pretreatment with noble metal compound/silane coupling agent and thickness of plating on such as surface, the Examiner has further cited the references to Uzoh, Maenosono and '898 as discussed in the **Grounds of Rejection** above. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

At pages 4-5 of the Appeal Brief, appellant argues that as to Uzoh teaching electroless copper plating over substrates formed from silicon wafers, the only discussion as to this is a general discussion in the background of the invention as to copper plating by electroless or electroplating over a substrate, and no specific disclosure as to plating over silicon wafers, with the reference providing all plating by electroplating. Also, appellant argues, since the primary reference to Kondo is concerned with articles having a roughened surface, the teachings in Uzoh should not transfer to Kondo.

The Examiner has reviewed these arguments, however, her position is maintained. Uzoh's teaching in the background is relevant as to what is conventionally known in the art. Uzoh at paragraph [0005] teaches that conductive materials such as copper "... are commonly used in integrated circuit interconnect applications. Copper may be plated by electroless or electroplating techniques on a substrate." Then in the next paragraph [0006], Uzoh exemplifies such a process for integrated circuits using a silicon wafer substrate and copper plating (with no limitation to electroless or electroplating). One of ordinary skill in the art would certainly understand that the sentence as to the plating of copper by electroless or electroplating in the same paragraph with the application of copper in integrated circuit applications would indicate that the electroless plating can be used for such a process. Sentences are not looked at in isolation, but in connection with the rest of the specification. Moreover, the Examiner notes that even if Uzoh's teaching were to be completely disregarded, '898 also shows, in the abstract, the known desire to overplate a mirrored semiconductor surface, where the semiconductor material can specifically be a silicon wafer (as in example 5) with electroless plating, which can be electrolessly plated copper (also in example 5) (see also pages 5 and 22-23 of the translation) and Kondo shows copper plating thickness in the claimed range as discussed above in this **Ground 1** arguments section. As to the teaching of roughening by Kondo, as discussed earlier in this section, Kondo is not limited to roughened surfaces, and the art used in the combination provides the conventionality of treating mirrored surfaces.

At pages 5-6 of the Appeal Brief, appellant further argues that while the Examiner has cited Maenosono as teaching that silicon wafers and other substrates with roughness of no more than 10 nm are commonly coated by electrochemical deposition methods, the plating method is electrochemical and not electroless plating as is required by the present claims. Furthermore, appellant argues, that in Maenosono the thin film is preferably made by a material that the resistance (adhesion) during peeling apart the polyamide film after the formation thereof is low, which means that the deposited thin layer of Maenosono is not desired to adhere to the substrate, which is opposite to that of the present invention and the other cited patents. Also, appellant argues, since the primary reference to Kondo is concerned with articles having a roughened surface, the teachings in Maenosono should not transfer to Kondo.

The Examiner has reviewed these arguments, however, her position is maintained. As to Maenosono disclosing electrochemical deposition and not electroless plating, the Examiner would understand that in the art of electrochemical deposition, electrochemical deposition is understood to be inclusive of electroless plating (as discussed at pages 9-10 of the Office Action of October 20, 2008). Furthermore, at the least, even if it does not specifically indicate electroless plating, it indicates the plating or otherwise coating of thin films on silicon wafers with roughness of 10 nm or less by a variety of methods is well known (paragraph [0030]), and '898 also teaches the desire to electrolessly plate mirrored finish surfaces, and, thus, Maenosono indicates a surface that it would be desired to plate, and expected to be able to electrolessly plate from the

teaching of '898. As to the thin film layer of Maenosono in paragraph [0030] not being adherent, the Examiner disagrees. Maenosono, in its process, peels an applied polyimide layer from the substrate (paragraph [0010]), and when the substrate is inclusive of the thin film of paragraph [0030], it would appear from the wording in paragraph [0030] that the resistance (adhesion) of the thin film to the polyimide is low, since it is the polyimide film that is removed and adhesion during peeling of the polyimide that is referred to. Again as to Kondo being limited to substrates with a chemically roughened surface, the Examiner disagrees for the reasons discussed is this **Ground 1** arguments section above.

At pages 6-7 of the Appeal Brief, appellant argues that since the primary reference to Kondo is concerned with plating an article having a roughened surface, '898 does not cure the deficiencies with respect to the combination of Kondo, Uzoh and Maenosono discussed above.

The Examiner has reviewed these arguments, however, her position is maintained. The Examiner notes '898's teaching, in the abstract, the known desire to overplate a mirrored semiconductor surface, where the semiconductor material can specifically be a silicon wafer (as in example 5) with electroless plating, which can be electrolessly plated copper (also in example 5), with the use of a catalyst applied by providing a admixing or reacting a noble metal compound as a catalyst with a silane coupling agent containing a functional group having the capability of capturing a metal, and applying this pretreating agent to the substrate surface before electrolessly plating.

Again as to Kondo being limited to substrates with a chemically roughened surface, the Examiner disagrees for the reasons discussed is this **Ground 1** arguments section above.

At page 7 of the Appeal Brief, appellant argues that the objective evidence of record further supports the patentability of the claims.

The Examiner has reviewed these arguments, however, her position is maintained. As to the comparative examples of appellant using formalin or glyoxylic acid alone, or a plating solution without stabilizer producing inferior results, the question is not whether different examples that do not include all the features of the claimed invention give different results, but rather whether the claimed invention is suggested by the combination of the references. It is the Examiner's position that the combination of the references does provide the suggestion of the claimed invention for the reasons discussed in the rejection above. The Examiner notes the primary reference to Kondo already provides the suggestion to use the additional hypophosphite reducing agent as required by claim 6 (rather than formalin alone) with an expectation of improved deposition rate as discussed in the rejection above. Therefore, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). Similarly the primary reference to Kondo also already provides the suggestion to use stabilizer in the form of 2, 2'-bipyridyl (see column 6, lines 25-35 and the use of 2,2'-bipyridyl in the TEA baths with both formalin and sodium

hypophosphite, column 13, lines 45-60). Furthermore, appellant has provided a listing of expected benefits to be provided from the use of the noble metal/silane pretreatment on a mirror surface with plating using a plating solution with the first and second reducing agents and stabilizer as claimed. However, as noted above, the suggestion to use the first and second reducing agents and stabilizer is provided by the primary reference to Kondo. Suggestion to use the noble metal/silane pretreatment agent on a mirror surface, and its benefits is provided by Uzoh. Appellant's examples provide no indication of using a mirror finish substrate or unexpected benefits from using such a substrate. As to lower temperature uniform plating from the stabilizer, this is not described in the examples or claimed, and as noted above, the same stabilizer as claimed is taught by Kondo.

Ground 2. The Rejection of Claim 5 under 35 USC 103(a) over Kondo in view of Uzoh, Maenosono, and '898 and further in view of Yoshida and Verbunt.

Appellant argues, at page 8 of the Appeal Brief, that claim 5 further limits claim 6, by requiring the first reducing agent to be glyoxylic acid and the second reducing agent to be hypophosphorous acid and the stabilizer to be 2, 2'-bipyridyl. Appellant further argues that the arguments as to Kondo in view of Uzoh, Maenosono, and '898 in **Ground 1** above apply to the rejection of claim 5. At pages 8-9 of the Appeal Brief, appellant further discusses why the Examiner cited Yoshida and Verbunt, but then argues that they do not cure the deficiencies provided by Kondo, Uzoh, Maenosono,

and '898. Furthermore, according to appellant, given the evidence of unobviousness with respect to claim 5 of the present specification shown in Example 2 of the present specification, even if a proper showing of prima facie obviousness of claim 5 was made, the objective evidence further establishes the patentability of presently presented claim 5.

The Examiner has reviewed these arguments, however, her position is maintained. The rejection using Kondo in view of Uzoh, Maenosono, '898 is proper as to claim 6 as discussed in **Ground 1** above, and therefore, also remains for **Ground 2**. The further use of Yoshida and Verbunt was for the specific reasons cited by the Examiner in the **Grounds of Rejection** above, and appellant has provided no reasoning against using these references and the Examiner's position as to these references, so the rejection is maintained. As to the specific Example 2 in the present specification showing non-obviouness, this example simply shows that plating was accomplished using a copper electroless plating solution containing glyoxylic acid, hypophosphorous acid and the stabilizer is 2, 2'-bipyridyl over the entire surface, and was formed uniformly without unevenness over the entire surface, with a film thickness of 50 nm. This is exactly the same results as in Examples 1, 3, 4, 5, 6 and 7, which use different copper electroless plating solutions without the specific combination of glyoxylic acid, hypophosphorous acid and the stabilizer of 2, 2'-bipyridyl; and thus no showing of specific unexpected benefits for the material of claim 5 is shown.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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